

- (1) Dorin B., 2021. Theory, Practice and Challenges of Agroecology in India, International Journal of Agricultural Sustainability
 (2) Dorin B., Joly P.-B., 2020. Modelling world agriculture as a learning machine? From mainstream models to AgriBiom 1.0, Land Use Policy, 96, pp. 103624
 (3) Dorin B., Aubron C., 2016. Croissance et revenu du travail agricole en Inde, Economie Rurale, 352, 41-65.
 (4) Dorin B., 2017. India and Africa in the Global Agricultural System (1960-2050), EPW, LII:25-26, 5-13.
 Dorin B., Hourcade J.-C., Benoit-Cattin M., 2013. A World without Farmers?, CIREP WP 47, Paris, 26 p.

Agroecological Food Systems for the 21st Century

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Agro-industrial scenario?



Workforce
Livelihood



A World Without Farmers



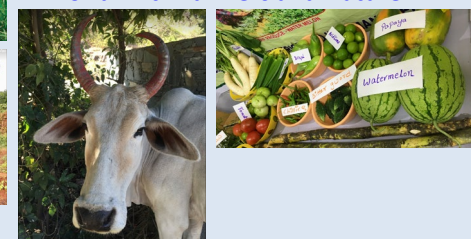
Food



Agroecological scenario?



A World With Farmers and Nature



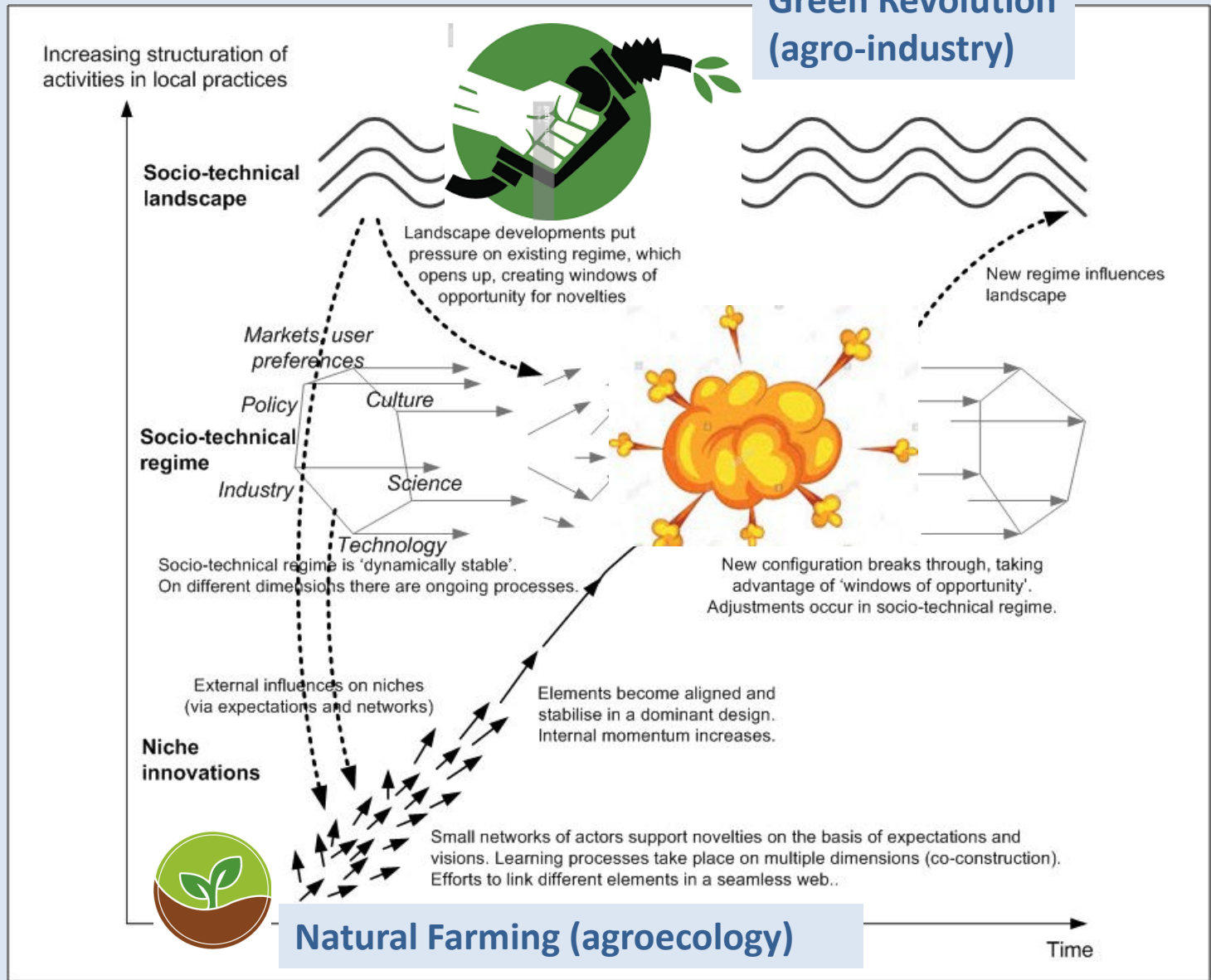
National Workshop on "Innovative Agriculture"
New Delhi, 25 April, 2022

Incremental innovation (GR) vs radical innovation (NF)

Green Revolution
(agro-industry)

Sociotechnical regime
(Schot and Geels, 2007)

Set of aligned rules that are carried by a range of actors (firms, users, government, scientists...) that together form a community for how to produce, use and regulate specific products and processes.



Geels F. W., Schot J., 2007. "Typology of sociotechnical transition pathways", Research Policy, 36:3, Apr, pp. 399-417

Agro-industry (GR) vs Agroecology (NF)

AGRO-INDUSTRY

- **Specialization** in a few standardized mass-productions (wheat, rice, corn, soya, palm oil, sugar cane, cow's milk...) to enable their mechanization/robotization and generate **economies of scale**, the profit-driver of any industrial activity
- With the use of **inputs produced by science & industry** to increase land productivity (genetic materials, water from dams, canals or pumps, fossil energy, chemical fertilizers, pesticides, herbicides or fungicides, growth hormones or antibiotics, robotics, artificial intelligence...)



AGROECOLOGY

Land and labour productivity based on a **mosaic of local agroecosystems** that, each in their own way, **stimulate and optimize biological synergies between many plant and animal species** beneath and upon the earth's surface, from soil fungi to cereals, pulses and trees, from bacteria or earthworms to large bovids (Dorin et al. 2013, Dorin 2017, Dorin 2021)



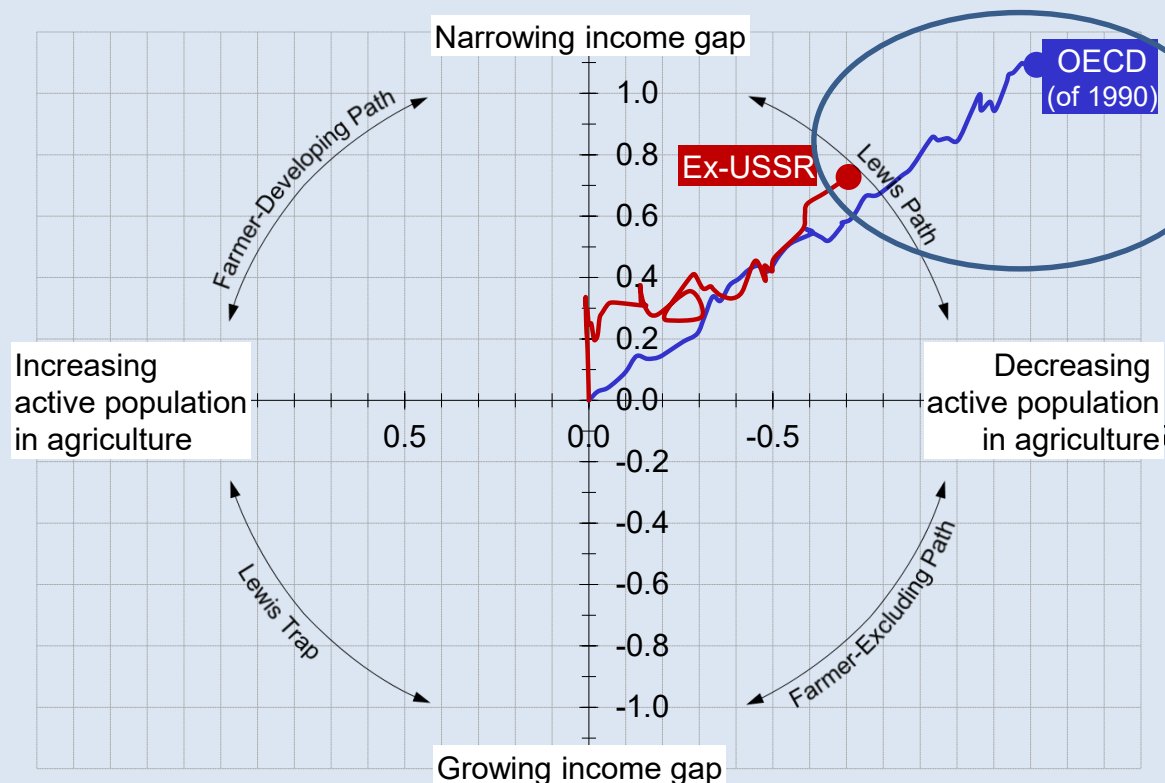
Success and dead ends of agro-industry

■ “Modern growth” & “Structural transformation” (Lewis 1954, Kuznets 1966...)

- Value (GDP) and jobs migrate from agriculture to industry and services
- Up to a “World Without Agriculture” (Timmer 2009): agriculture = 2-3% GDP & 2-3% employment
- With:
 - large specialized, chemical and robotized farms (thanks to abundant and cheap fossil fuels...)
 - cheap (but unhealthy...) food (household income is no longer just for food!)
 - income convergence between farmers and nonfarmers (rural poverty eradicated !)

■ The “Lewis Path” of the OECD countries (Dorin 2013)

Path of structural transformation (1970-2019)



« LEWIS PATH »

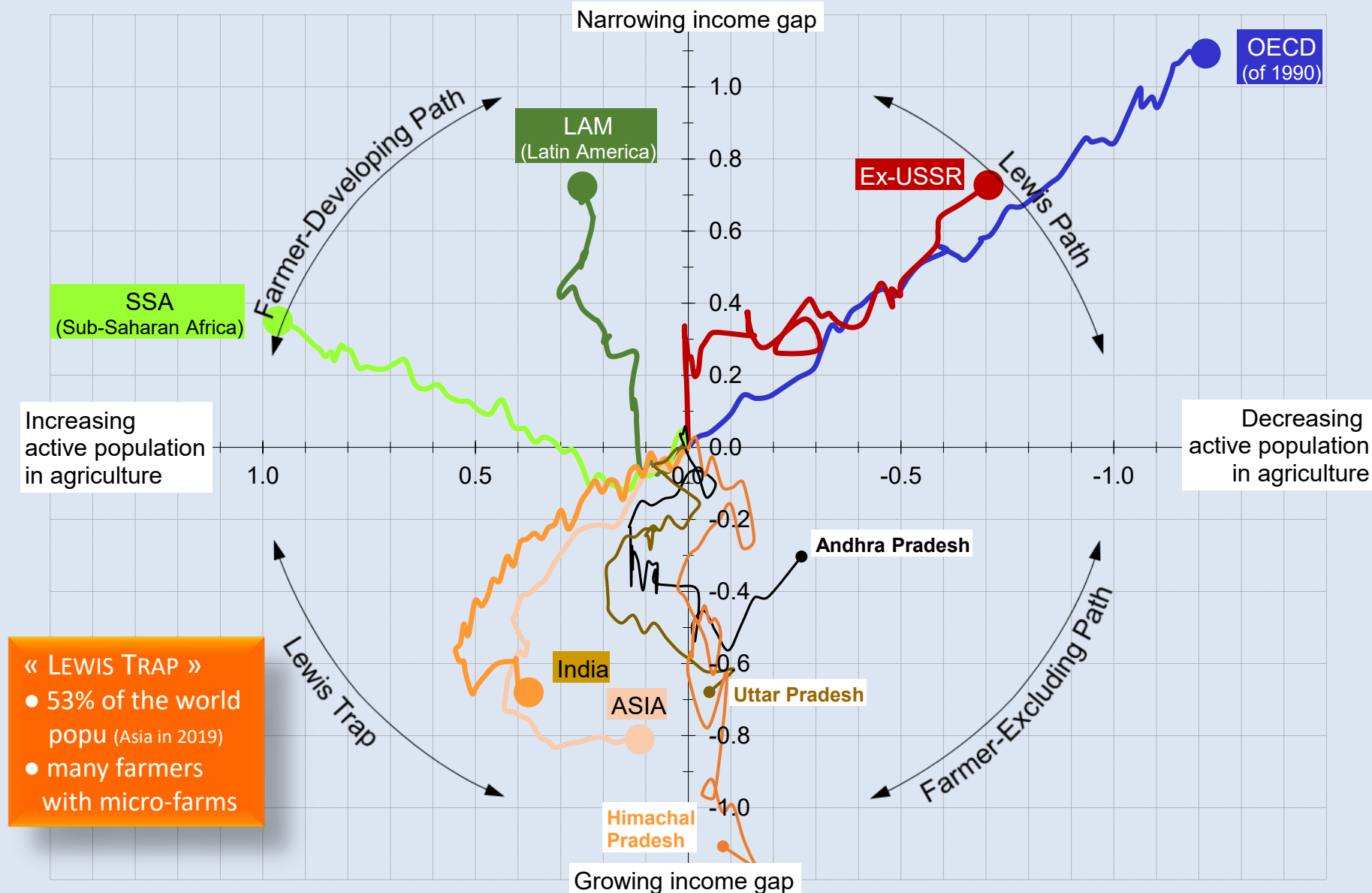
- 18% of the world population (2019)
- very few farmers but large farms
- a “World Without Agriculture”
(share of agriculture in GDP & jobs < 3%)

Source:

Dorin 2022 (provisional), based on:

- Dorin et al. 2013 : paths/metrics
- ILO 2022 : employment by sector
- UNSTAT, 2022 : Gross Value Added at constant 2015 USD

■ But the world is rather in a “Lewis Trap” (Dorin 2013, 2016, 2017, 2021)



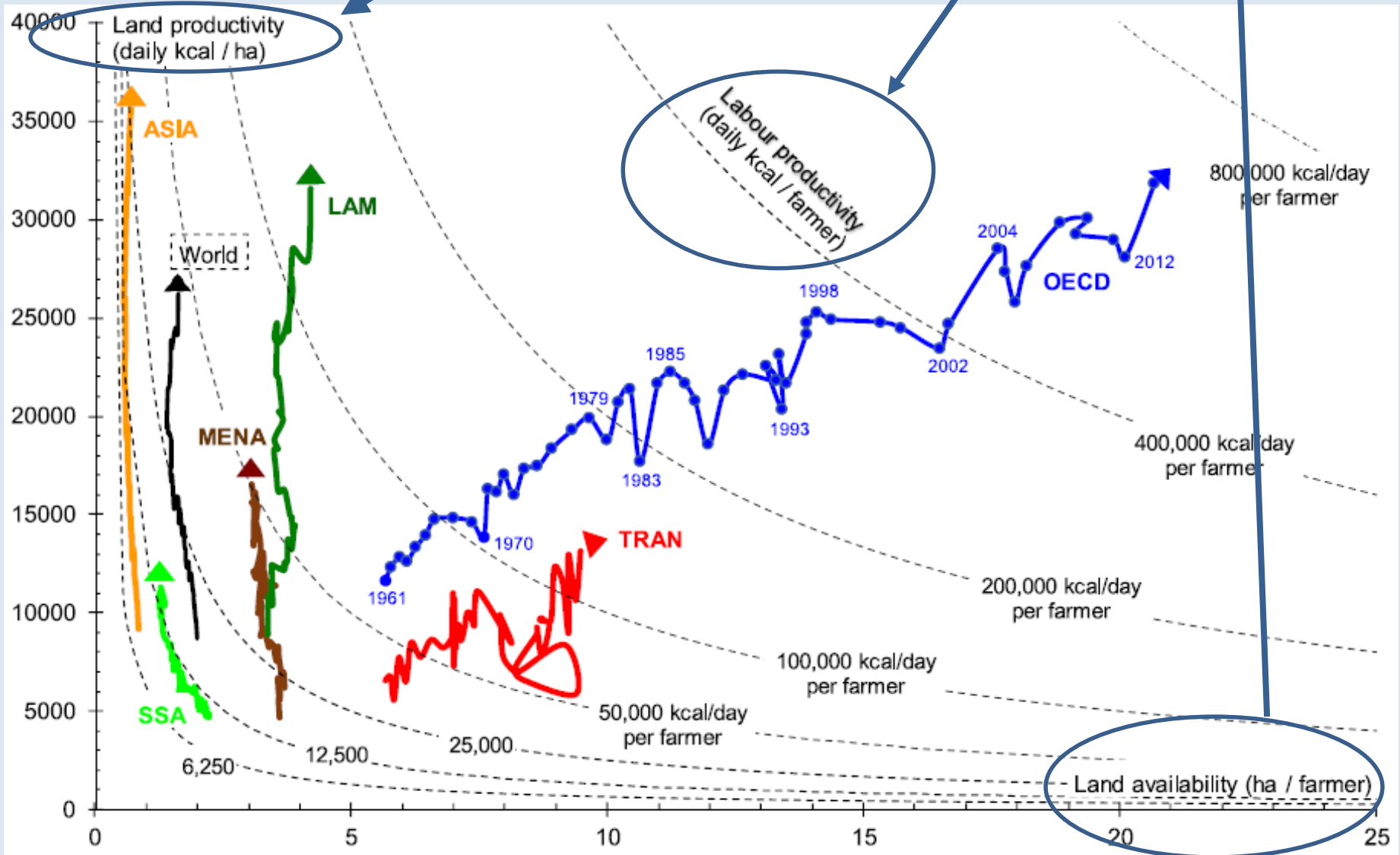
Source: Dorin 2022 (provisional), based on Dorin et al. 2013

- World Regions and India: from 1970 (centre) to 2019, with Gross Value Added at Constant 2015 USD (UNSTAT, 2022)

- Indian States (undivided): from 1980 (centre) to 2019, with Gross Value Added at Constant 2011-12 INR (GOI, 2021)

■ ...despite highest yields in Asia!

The more land you farm (with robots...) the higher your labour productivity

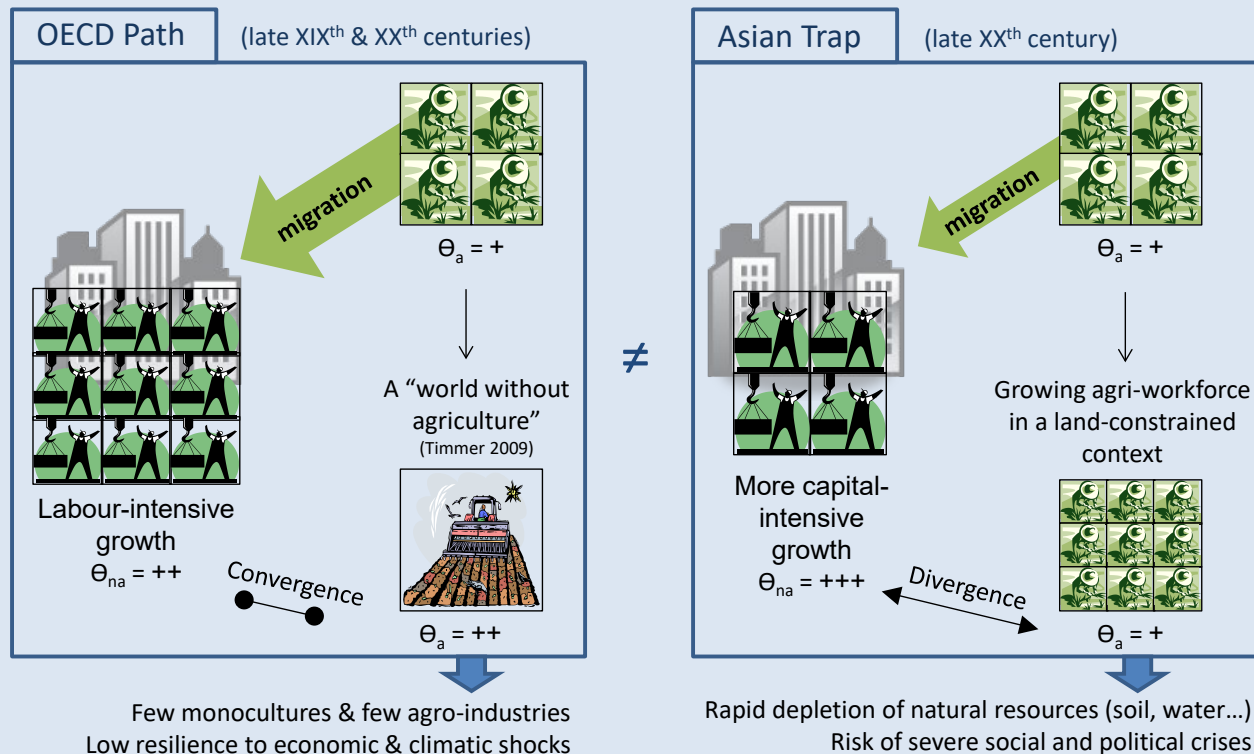


World paths of agricultural productivities (1961-2013)

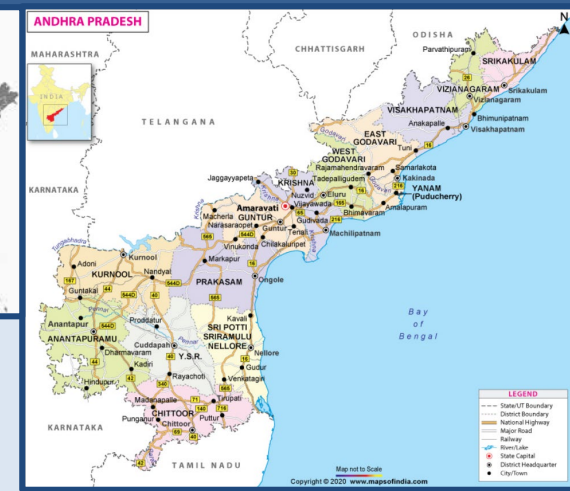
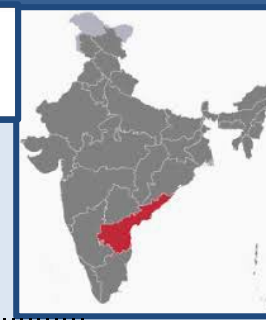
Source: Dorin 2021

■ Dead ends of industrial/chemical agriculture for small farmers...

- (1) Nonfarm sectors are less and less labour-intensive (robotization with abundant fossil-energy...)
- (2) Population and farmers have increased since the 1960s
- (3) Farm size shrunk instead of enlarging as in the OECD countries (impossible/unprofitable robotization...)
- (4) Industrial agriculture (specialisation and chemicalization) boosted yields
but didn't compensate shrinking surfaces while increasing risks & costs per ha
- (5) Income gap between farmers and nonfarmers widened further ("agrarian crisis" and "protests" in India)
- (6) Heavy incentives/subsidies to the mass production of few industrial monocultures
(in India, tens of billions of euros per year of input and price subsidies for a few products: rice, wheat, sugarcane...)
further digs into a socioeconomic, nutritional and environmental trap (soil, water, air, biodiversity, GHG...)



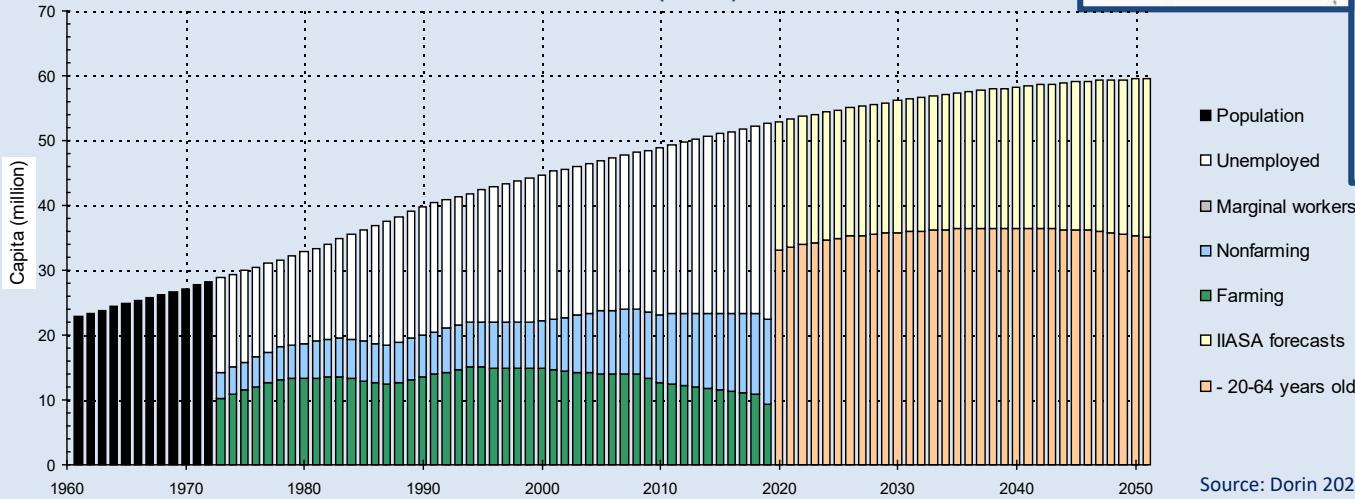
Andhra in 2050?



Source: www.mapsofindia.com

Retrospective overview until 2019

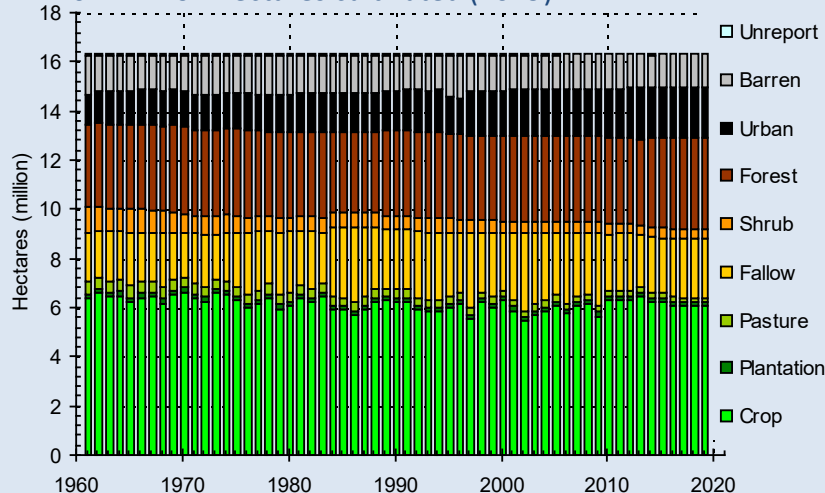
Population & employment (1961-2019) + IASA projections
53 million inhabitants and 10 million farmers (2019)



Source: Dorin 2021 (Agribiom-India)

Land use (1961-2019)

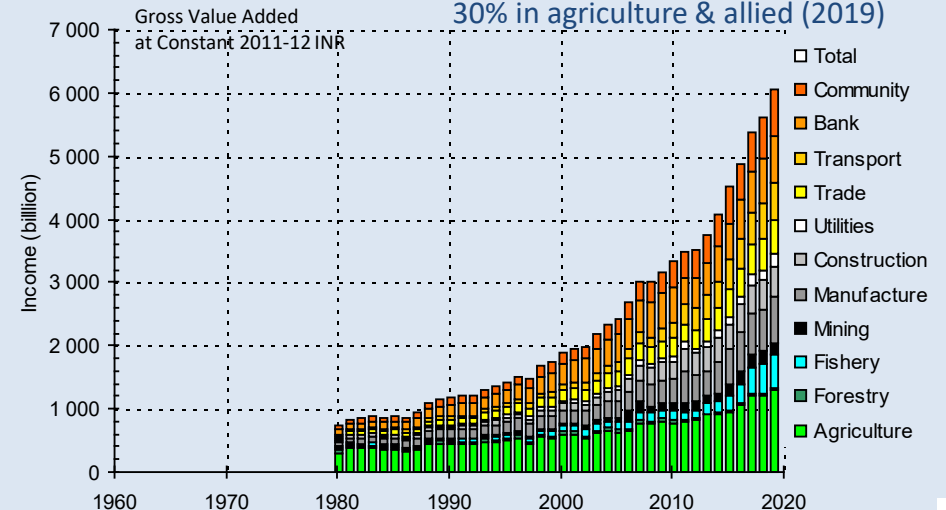
6.2 million hectares cultivated (2019)



GDP (1980-2019)

+5.8% (1980-2019)

30% in agriculture & allied (2019)



■ **Scenarios for 2050** (RySS-Cirad-FAO foresight study 2018-2022, provisional results)

2050 (from 2019)	100% Industrial	100% Natural
Population (million capita)	59.5 (+0.4% p.a.)	59.5 (+0.4% p.a.)
Workforce (20-64 years)	35.4 (+0.3% p.a.)	35.4 (+0.3% p.a.)
Unemployment	10.6 (30%)	0 (0%)
Employment	24.8 (70%)	35.4 (100%)
- Farmers	5.0 (20%)	12.4 (35%)
- Nonfarmers	19.8 (80%)	23.0 (65%)
Cropland (million ha)	5.5 M (-0.4% p.a.)	8.3 (+0.9% p.a.)
GVA (trillion INR-2011)	36.9 (+6.0% p.a.)	42.6 (+6.5% p.a.)
- Farm sector	5.4 (+3.5% p.a.)	11.2 (+6% p.a.)
- Nonfarm sector	31.5 (+6.7% p.a.)	31.4 (+6.7% p.a.)
Productivity (INR/day)	4080 (+5.7% p.a.)	3307 (+5.0% p.a.)
- Cropland (ha)	2670 (+3.9% p.a.)	3719 (+5.0% p.a.)
- Farmer	2967 (+5.6% p.a.)	2489 (+5.0% p.a.)
- Nonfarmer	4359 (+5.3% p.a.)	3748 (+4.8% p.a.)
Agri income gap (INR/day)	1392	1259
Structural Path (2019-2050)	Farmer Excluding	Farmer Developing

Social policies
Universal Basic Income
at 1450 INR/cap/day
Input & price subsidies
to close the gap

22% of GDP

**Environmental services
without scale economies**
PES/farmer to close de gap

13% of GDP

Conclusion

All in all, today's societies have to choose between two contrasting paths:

- 1 continue to massively produce a few products that are processed and assembled downstream, where market values, investments and jobs are increasingly concentrated, particularly to resolve the social and environmental flaws in the system (rising costs of healthcare, water depletion & pollution, soil and biodiversity erosion, climate change...)
- 2 produce in symbiosis in and with nature, with markets values, investments and jobs concentrated upstream to provide a diversity of quality products, as well as services (to be paid unlike today) such as water filtering, soil carbon sequestration, or resilience to biotic and abiotic shocks (energy price, climate change...)



With hundreds millions of micro-farmers
(best insurance for high yields + people & nature health)
India has a comparative advantage
to gain and lead with option 2